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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/800,550	03/07/2001	Harpreet Singh Sawhney	SAR 13825	4094
26581	7590	04/07/2004	EXAMINER CHAWAN, SHEELA C	
RATNERPRESTIA P.O. BOX 980 VALLEY FORGE, PA 19482-0980			ART UNIT 2625	
			PAPER NUMBER	

DATE MAILED: 04/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/800,550

Applicant(s)

SAWHNEY ET AL.

Examiner

Sheela C Chawan

Art Unit

2625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 19 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) 12-14 and 27-40 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 19-26 is/are allowed.
- 6) ☒ Claim(s) 1-6, 15-18, 41 and 42 is/are rejected.
- 7) ☒ Claim(s) 7-11 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 5.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_.

**DETAILED ACTION**

**Election/Restriction**

1. Applicant's election was made without traverse in Paper No. 7, filed March 19, 2004 is acknowledged. Applicant elected group I, claims 1-11, 15-26, 41 and 42.
2. Claims 12-14, 27- 40 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

***Drawings***

3. The drawings are objected to because of drafter's remarks (see attached PTO-948 paper number 8). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 U.S.C. § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1- 6, 15,16, 41 and 42 are rejected under 35 U.S.C. 102(e) as being anticipated by Sundareswaran et al. (US. 6,330,356 B1).

As to claim 1, Sundareswaran discloses a method for accurately estimating a pose of a camera (fig 1, 20) within a scene using a three-dimension model of the scene (fig 1, 30, column 6, lines 7-14, 19- 24), comprising the steps of:

- (a) generating an initial estimate of the pose (column 6, lines 19-42);
- (b) selecting a set of relevant features (ring shaped marker corresponds to features, fig 3, 72) of the three dimensional model based on the initial estimate of the pose (column 6, lines 37- 48);
- (c) creating a virtual projection (column 4, lines 12- 21) of the set of relevant features responsive to the initial estimate of the pose (column 6, lines 48- 58, column 7, lines 2-58);
- (d) matching a plurality of features of an image received from the camera to the virtual projection of the set of relevant features and measuring a plurality of matching errors (computing a disparity between the positions of the features and corresponding positions of features in a calculated projection of a stored, three-dimensional object model CAD, and calculated projection based on a virtual camera model, column 8, lines 56- 67, column 9, line1 to column 10, lines 1- 56); and
- (e) updating (based on the position and orientation parameters of the virtual camera are identified by rotating and shifting the virtual camera point of view, column 11, lines 2-7) the estimate of the pose to reduce the plurality of matching errors (fig 1

and 7, column 6, lines 60- 67, column 8, lines 56-67, column 9, line 1 to column 10, lines 1-56).

As to claim 15, see the rejection of claim 1.

As to claim 41, see the rejection of claim 1.

As to claim 42, claim 42 recites similar limitation as claim 1 above and similarly analyzed except for the step (f) point of view refinement means for updating the estimate of the point of view to reduce the plurality of matching errors (column 8, line 56- 67, column 9, lines 1- 45, column 10, lines 52- 56); and

(g) model refinement means, responsive to the estimated point of view and to the image, for updating the three-dimensional model as taught by Sundareswaran (column 8, line 56- 67, column 9, lines 1- 45, column 10, lines 52- 56).

As to claim 2, Sundareswaran discloses the method further comprising the step of:

(f) repeating to steps (c), (d), and (e) using the updated estimate of the pose until the plurality of matching errors are less than predetermined matching criteria (fig 1 and 7, column 6, lines 60- 67, column 8, lines 56-67, column 9, line 1 to column 10, lines 1- 56).

As to claim 3, Sundareswaran discloses the method further comprising the steps of:

(f) adding the updates to the estimate of the pose made in step (e) to a total change value of the estimate of the pose (fig 1 and 7, column 6, lines 60- 67, column 8, lines 56-67, column 9, line 1 to column 10, lines 1-56).

(g) if the total change value is less than predetermined (column 7, lines 32- 35, column 9, lines 7-38) pose change criteria (column 4, lines 12- 21), resetting the total change value and repeating to steps (b), (c), (d), (e) and (f) using the updated estimate of the pose (column 6, lines 60- 67, column 11, lines 2-7); and

(h) repeating to steps (c), (d), (e), (f) and (g) using the updated estimate of the pose until the plurality of matching errors to are less than predetermined matching criteria (fig 1 and 7, column 6, lines 60- 67, column 8, lines 56-67, column 9, line 1 to column 10, lines 1-56).

As to claim 4, Sundareswaran discloses the method wherein step (a) includes the step of comparing an image received from the camera to the three-dimensional model of the scene to generate the estimate of the pose (column 11, lines 17-58).

As to claim 5, Sundareswaran discloses the method wherein step (a) includes the step of using a preceding pose estimate of a preceding image received from the camera to generate the estimate of the pose (column 6, lines 60- 67, column 8, lines 56-67).

As to claim 6, Sundareswaran discloses the method wherein step (b) includes the steps of:

b1) Z-buffering the three dimensional model based on the estimated pose to determine a set of visible features of the three dimensional model (column 4, lines 13-36, column 11, lines 17-67, column 12, lines 1-5); and

(b2) selecting the set of relevant features from the set of visible features (column 4, lines 13-36).

As to claim 16, Sundareswaran discloses the method wherein step (b) includes the step of:

(b) projecting a plurality of color values of the image onto the three dimension model of the scene to update a texture of a surface of the three dimensional model (column 6, lines 19- 25).

*Claim Rejections - 35 U.S.C. § 102*

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 17 and 18 are rejected under 35 U.S.C. 102(b) as being anticipated by Cox et al. (US. 5,644,651).

As to claim 17, Cox discloses a method for accurately estimating a position of remote vehicle using (column 6, lines 21-31) a three-dimension model and an image from a camera having a known orientation relative to the remote vehicle (column 1, lines 62- 67, column 2, lines 1-31), comprising the steps of:

(a) comparing the image to the three dimension (column 1, lines 8-12) model of the scene to generate an estimate of the pose (column 2, lines 24-53, column 4, lines 53-60);

(b) selecting a set of relevant features (epipolar lines are considered to be a set of features, column 3, lines 8-22) of the three dimensional model based on the estimate of the pose (column 5, lines 7- 42);

(c) matching (column 4, lines 12-67) a plurality of features of the image to the set of relevant features and measuring a plurality of matching errors (column 5, lines 7- 42);

(d) updating the estimate of the pose based on the plurality of matching errors (column 5, lines 1-67, column 6, lines 1-31); and

(e) determining the position of the remote vehicle based on the estimate of the pose and the orientation of the camera (column 6, lines 21-31).

As to claim 18, Cox discloses the method of claim 17, further comprising the step of:

(f) updating the three dimensional model based on data from the image and the updated estimate of the pose (column 5, lines 1-67, column 6, lines 1-31).

*Allowable Subject Matter*

6. Claims 7- 11, are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.



***Reason For Allowance***

7. Regarding claim 19, The prior art of record fails to teach or suggest, alone or in combination, a method for refining a three dimensional model of a scene containing an object using a plurality of images of the scene, each image including the object, comprising the step of: (d) matching a plurality of first features of the first image to the first set of relevant features and measuring a plurality of first matching errors;

(f) matching a plurality of second features of the second image to the second set of relevant features and measuring a plurality of second matching errors.

Claim 19-23 are allowed.

Regarding claim 24, The prior art of record fails to teach or suggest, alone or in combination, a method for refining a three dimensional model of a scene containing an object using a plurality of images of the scene, each image including the object, comprising the step of: (a) selecting a subset of images from the plurality of images of the scene, the subset of frames containing at least two of the images;

(c) comparing each image in the subset of images to the three dimensional model to generate a subset of estimated viewpoints corresponding to the subset of images, the subset of estimated viewpoints constrained by the plurality of approximate relative viewpoints;

(e) matching a plurality of features of the each image in the subset of images to the corresponding set of relevant features and measuring a plurality of matching errors.

Claim 24 - 26 are allowed.

*Other prior art cited*

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Anandan et al. (US.6,192,145B1) discloses method and apparatus for three-dimensional scene processing using parallax geometry of pairs of points.

Kumar et al. (US.6,522,787B1) discloses method and system for rendering and combining images to form a synthesized view of a scene containing image information from a second image.

Imaizumi et al.(US. 6,047,087) discloses image processor.

Martin et al. (US.5,850,469) discloses real time tracking of camera pose.

*Contact Information*

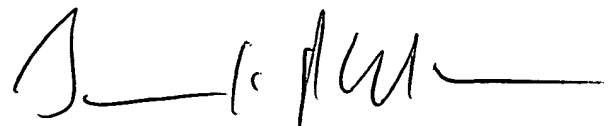
9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sheela C Chawan whose telephone number is 703-305- 4876. The examiner can normally be reached on Monday - Thursday 6 - 7.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on 703-308-5246. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

*SCC*

Sheela Chawan  
Patent Examiner  
Group Art Unit 2625  
April 2, 2004



Jayanti K. Patel  
Primary Examiner